

NEXT STOP, SECURITY: UNDERSTANDING WHAT MAKES WOMEN FEEL  
SAFE IN PUBLIC TRANSPORTATION STATIONS

A Thesis

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by

Christine Sudabeh Majd

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## **ABSTRACT**

While considerable research has been done on women's heightened fear of public transportation, little research has been devoted to the role of the built environment and its impact on women's perceptions of personal safety. This is particularly true in the United States which is significantly behind other countries on the issue of transit safety for women. This study, which focused on subway platforms, questioned the effectiveness of Crime Prevention Through Environmental Design (CPTED) in alleviating these fears and, specifically, what women find to be important when assessing the perceived safety of an environment.

An online survey was the method of data collection. Participants provided demographic and travel behavior information. They were also asked to rank the importance of eight common security tactics and strategies. Lastly, participants were shown photos from the Washington DC, Chicago, and New York City subway systems and asked to rate their level of satisfaction with their overall sense of personal safety, sightlines, and security hardware.

Data analysis revealed that the design of the subway platform influences user's perception of personal safety. Female participants scored personal safety in the Washington Metro higher than the older Chicago and New York City subway systems. Respondents ranked "lighting" and "other passengers" as the first and second most important characteristics. Other common crime prevention tools such as security cameras and emergency phones were ranked fourth and fifth place, respectively. There were no significant differences in ranking between male and female participants. Research findings support the popular assumption among transit authorities that female passengers prefer the presence of police officers over any security hardware. The paper ends a recommendation to reduce the amount of funding dedicated to the purchasing of security hardware technology.

## **BIOGRAPHICAL SKETCH**

Sudy Majd received her Bachelor of Arts degree in Economics from the Barnard College in 2006. During her time at Barnard, she became interested in behavioral economics, specifically in the retail environment. After graduating, Sudy worked for a retail space and market research consulting firm studying how the physical layout of stores influence customer shopping patterns and behaviors. It was during this time she began to appreciate the power of the built environment and its ability to subconsciously dictate how individuals behave. With a desire to further study the subject, she returned to school in 2010 to attend Cornell University to pursue a Master of Science in Applied Research in Human Environment Relations within the department of Design and Environmental Analysis. After graduation, she plans to pursue a PhD in consumer behavior and food psychology. Sudy hopes to join the battle against adult and childhood worldwide obesity through the manipulation of the built environment.

Dedicated to my mommy, Zo

## ACKNOWLEDGMENTS

I would like to acknowledge Professors Gary Evans, Thomas DiCiccio, and Nancy Wells for all of their support and encouragement throughout the duration of this study. I gained so much more out of my graduate experience because of their advice, leadership and humor.

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## CHAPTER 1

### Introduction

#### 1.1. Introduction

Public transportation systems in North America rely heavily on revenue from riders, and it is an essential part of a system's success (Shen, Ospina, Zhao, & Elbadrawi, 1997; Schulz, Gilbert, 1996). In addition, there are important social, economic and environmental benefits to be gained from increased use of public transportation. Reduced road congestion, shorter travel time, fewer road fatalities and injuries, and less pollution are some of the benefits. Ensuring passenger safety is a prerequisite to gaining and keeping a loyal ridership (Litman, 2012). Inevitably, some passengers experience fear of victimization which leads to a change in travel behavior: "This does not bode well for transit agencies, which have learned within the past 20 years that citizens are far more fearful of their transit systems than they are of their city streets" (Del Castillo, 1992). Research has shown that women have much higher levels of fear in public transportation systems and often respond by opting for alternative modes or avoiding public transit altogether. These changes in travel behavior can dramatically impact the level of ridership with accumulating long-run impacts on the system (Wallace, Rodriguez, White & Levine, 1999; Del Castillo, 1992). In addition, reduced use of public transportation inevitably results in greater road congestion, and increased pollution, just to mention the most obvious. In a post 9/11 world, security has become an even greater concern for transportation agencies and passengers, and yet research on women, fear, and the transportation environment has lagged. When it comes to understanding personal safety, there is an apparent disconnect between riders and practitioners (transit agencies and police authorities) as well as riders and researchers. By using crime statistics as their principal measure of safety, practitioners underestimate the frequency of

offenses and subsequent effects. Moreover, by concentrating on macro crime figures, researchers who have studied how personal safety differs by gender, have neglected to study this problem at the micro level. This is possibly due to the misconception that men use public transportation more than women. A re-examination of transportation data uncovered evidence that female transportation behaviors were not being sufficiently captured. Female riders, who tend to make more side trips during their commutes, had been incorrectly categorized which underrepresented how much time and distance they spent traveling (Jaffe, 2012).

Attempts by transit agencies to improve safety have been identified by female passengers as not particularly comforting (Loukaitou-Sideris & Fink, 2009). Furthermore, there is some evidence that Crime Prevention Through Environmental Design (CPTED) design strategies, which is the concept of preventing and reducing criminal activity through the manipulation of the physical environment, have, in fact, a negative effect on perceptions of personal safety. There is a general understanding of factors that impact female passengers' fear of crime but applying this knowledge to a specific setting has yet to be done. With a focus on subway station platforms, this study hopes to narrow the gap between riders and practitioners and researchers by identifying aspects of the built environment having the least and greatest impact on the personal safety of female passengers. It is hoped that future security strategies can diminish fear of crime while improving passenger safety. This chapter first addresses the shortcomings of the subway system crime statistics in understanding personal safety. It discusses next the differences in perceptions of personal safety of male versus female passengers. The third section discusses the locations of crime within train stations and how CPTED strategies may be negatively affecting personal safety. The fourth section describes safety and security strategies being used by transportation agencies as reported by Loukaitou-Sideris & Fink (2009).

The first chapter is followed by four supporting chapter. Chapter 2 is a case study of crime in the Washington DC Metro system. Despite its claim for being the safest system in the country, selected articles from The Washington Post present a contrasting story. Chapter 3 explains study methodology and rationale behind survey questions. Chapter 4 discusses statistical analyses and results. The final chapter discusses study limitations, research implications, and recommendations based on study findings.

## 1.2. Crime Statistics and Personal Safety

Using crime statistics as a means to gauge passengers' feelings of personal safety is somewhat ineffective as many offenses go unreported, and crime statistics do not capture potential long lasting changes in behavior. Chapter two describes the Washington Metro's practice of reporting crime in Metro stations and vicinity. It is shown that, given the shortcomings of the Metro's crime figures, the statistics do not provide an accurate nor satisfactory measure of crime in the system (Sun & Layton, 2005).

The discrepancy between crime statistics and actual crime in subway systems was also one of the major findings from a survey conducted by the New York City Office of Manhattan Borough President, Scott Stringer. In 2007, 1,790 New York City male and female subway riders responded to an online survey asking about their experiences and impressions of sexual harassment and assault in the New York subway system. 67% of survey respondents were female. In the survey, sexual harassment was defined as "unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature, including flashing, groping, fondling, and public masturbation." Sexual assault was defined as "any non-consensual sexual acts," including attempted rape, rape, and "aggravated touching" (Stinger, 2007, p. 8-9).

Of the 1,790 respondents, 69% reported having felt the threat of sexual harassment or assault, 63% reported having been sexually harassed and 10% reported having been sexually assaulted in the New York subway system. Though the pervasiveness of these acts is appalling, even more shocking is the rate of which these incidences go unreported. 96% of those who reported having been sexually harassed did not contact authorities to file a report or seek assistance. Similarly, 86% of those who reported having been sexually assaulted did not contact authorities to file a report or seek assistance. In almost all of the incidences of sexual assault or harassment, females were the victims and males the perpetrators. When asked why they did not report these incidences to authorities, many participants said they did not think the offense was enough to constitute a crime. Others said that there were no police officers or transit representatives nearby. For those who did file a report, they said the time it took for authorities to arrive at the scene prevented any apprehension of the offender. Though actual crime statistics from the New York City Metropolitan Transit Authority are not available, it can be assumed that actual rates of crime are higher than official reports. It is apparent that crime statistics cannot be used to accurately assess the safety of a system let alone understand passengers' perception of personal safety. Furthermore, the survey also shows that passengers' fear of victimization is legitimate. This goes against what some of transit agencies believe, namely that fear of crime is unjustified (Loukaitou-Sideris & Fink, 2009).

The individualized interpretation and long lasting effects of offenses cannot be captured by a police report. Crime statistics are more of a concern for the police, who are interested in specific crimes (Lynch & Atkins, 1988). For example, the 63% of respondents who reported having been sexually harassed most likely experienced some short and long term effects but, from the perspective of security officials, sexual harassment is not considered a serious offense.

Police reports or the frequency of unpleasant experiences within public transportation systems are not an accurate evaluation of consequential behavior, particularly long term adjustments in behavior due to safety concerns. Therefore, it is necessary that research concerned with personal safety be targeted at existing riders rather than rely upon rates of crime.

### 1.3. Perceptions of Personal Safety: Men vs. Women

To understand people's perception of personal safety in public transportation, one must first examine the built environment in which these feelings manifest themselves. According to Smith and Clarke (2000, p. 169), "Crimes cannot be properly explained, nor effectively prevented, without a thorough understanding of the environments in which they occur." The built environments in public transportation settings are a particularly difficult setting to control and understand for a variety of reasons. For example, consider an underground train station platform from the perspective of both a passenger and a person willing to commit a crime. First, access to the platform is for anyone who pays and, sometimes, for those who choose not to pay. And so, because it is a shared public territory that is open to anyone, it lacks a level of ownership that would otherwise demand particular social behaviors. Therefore, peoples' behaviors are relatively unpredictable and uncontrollable. This is unappealing to a passenger while appealing to the potential offender. The potential target of victimization, the passenger, is also stationary and exposed, with personal belongings such as backpacks and purses visible. This becomes a particular problem when overcrowding occurs because people are unable to properly guard their property and visually survey their surroundings. Additionally, the behavior and pathways of passengers using public transit are both predictable and limited. This type of scenario is in line with routine activity theory which states that crime will occur depending on the presence of three

factors: a motivated offender, a susceptible target, and the lack of a capable guardian (Sherman, 1995). Compared to the streets, this environment is much more difficult to control and prevent crime. From a passenger's point of view, using public transportation may make them feel vulnerable due to strangers' erratic behaviors. From an offender's point of view, the context is somewhat ideal given people's predictable movements, a wider range of acceptable behavior, and overcrowding.

In 1997, Smith and Torstensson found a difference in perceptions of risk and fear among men and women when exposed to the same urban environment. From May to August 1994, Smith and Torstensson collected survey data using a mail questionnaire measuring people's fear of victimization in their homes and public transit. Using a simple random sampling frame, 3,882 people from 8 districts in Stockholm participated (a 78 percent response rate). Survey results showed fear, which was defined as "assessing the risk of victimization," was higher among women than men across a number of contexts (Smith & Torstensson, 1997, p. 609). Specifically, the proportion fearful in "Riding underground, bus, or train at night" of men versus women was 17% and 43%, respectively, further reinforcing women's fear of this particular environment. But what aspects of the built environments made respondents fearful was not asked. However, because the survey was sent to the homes of people living in the same 8 districts, it can be assumed that male and female participants were answering questions based on the same environments. Smith and Torstensson conclude that even when dealing with the same environments, there seems to be more of a generalized and heightened sense of fear across space among females than males. In other words, there may be something within the built environment that affects women's fear of victimization more so than men. Understanding the specific aspects of the environment that invoke this fear among women is an integral aspect of improving

personal safety. It is important to recognize, however, that data from Sweden may not generalize to the United States due to much lower rates of crime.

While much of the research on women's fear of crime in transportation environments, transit safety and actions taken by transit authorities has been carried out abroad, the subject has received relatively little attention in the United States. In a study of domestic safety and security strategies, Anastasia Loukaitou-Sideris et al. (2009) interviewed 16 representatives of different women's interest groups focused on women's needs, fears, and aspirations for safe travel. They also surveyed 131 U.S. transit agencies about general safety strategies, and safety strategies specifically for women. Of the 16 representatives interviewed from women's interest groups, many said that while violent attacks in public transit are of concern, sexual assault and harassment were highly problematic and severely under-reported. This claim is consistent with survey results from the 2007 above-reported study of sexual harassment and sexual assault in the New York City subway system which found that 63% of respondents said to have been sexually harassed while using the subway system and 96% of those respondents did not report the incident to the police or transit authorities (Stringer, 2007). While the representatives interviewed emphasized the presence of staff members tasked with monitoring an area as irreplaceable by technology or design strategies, the built environment was discussed at length as a solution tool.

Removal of litter, graffiti, and the general maintenance of the system increased comfort in riders: "Keeping an environment clean not only encourages positive behavior therefore discouraging potential perpetrators; it also makes things feel comfortable for someone who might have anxiety or fear" (Loukaitou-Sideris & Fink, 2009, p. 18) This is in accordance with the broken windows theory which states that the physical condition of an environment plays a role in determining how one is expected to behave. A well maintained area sends the signal that it is

being monitored and any damage will be readily apparent whereas a poorly maintained area sends the signal that it is uncared for and any further damage done will not matter (Kelling & Wilson, 1982). “Good” lighting and visibility were also extremely important safety features. Technology providing real time scheduling information gave respondents a sense of control and relief from the feeling of being stranded, a feeling which increases fear of vulnerability to an attack. This portion of the study helped re-emphasize the special needs of female travelers and the various ways in which their anxiety can be alleviated with changes through environmental design being one of them. The results of Loukaitou-Sideris et al.’s study provided the basis for asking women survey participants to rate train platform lighting, sightlines, and maintenance. The pictures with the real time scheduling information digitally added will give further insight about this technology’s impact on perceived personal safety.

Loukaitou-Sideris et al. also surveyed 131 U.S. transit agencies across the country (53% response rate). The 131 transit agencies varied in size, with a minimum of 50 vehicles in service during peak periods. The survey had two aims. The first was to see what, if anything, the industry was doing specifically for female riders. The survey also aimed to collect and understand the types of strategies the public transit industry uses, or plans to use, for the safety of their passengers. The latter purpose will be discussed in the following section. To better understand transit agencies opinions and efforts towards the safety and security of their female passengers, a series of survey questions asked whether the agencies believed: 1) female passengers have unique security needs; 2) if there should be specific safety programs targeting female passengers; 3) if such programs existed in their agency; and 4) if other transit agencies had such programs in place.



Of the 131 transit agencies surveyed, 87 agencies (67%) agreed that females have unique security needs. That being said, only a third of those same agencies believed transit agencies should have safety programs in place specifically for females and none of the transit agencies surveyed actually had established female specific programs. 39% of agencies reported existing programs targeted at specific populations, such as minors and the elderly, but not specifically for women. According to the authors, having so few agencies with existing programs significantly puts the United States behind other countries regarding the issue of female transit safety.

“Canada, the United Kingdom, Australia, Germany, Sweden, Mexico, and Japan, among other countries, have initiated and practiced a variety of measures to ease the fear of women passengers and provide them with more safe and secure public transportation” (p. 32).

The 87 agencies that believed females have unique safety requirements compared to men supported this claim with a number of reasons, the first being physical vulnerability. Agencies said that women had particular needs because criminals knew they could more easily overpower a woman than a man. Some agencies believed this fear of victimization is somewhat self-imposed by women. For example, according to a male risk manager, “Female passengers tend to believe they are vulnerable” (p. 30). While it is possible that women tend to over generalize fear across time, space, and types of crime, as noted above, research has shown that crime statistics do not accurately reflect the rate of actual crime occurring in the public transportation realm. Other agencies said that the ways in which women travel make them more vulnerable. For example, women carrying a purse/hand bag could be more susceptible to attacks because the offender can visually connect with the reward. Women traveling with young children and grocery bags could also attract offenders. Justifying the belief that women have particular security needs due to their physical size and natural tendency to have a heightened fear of

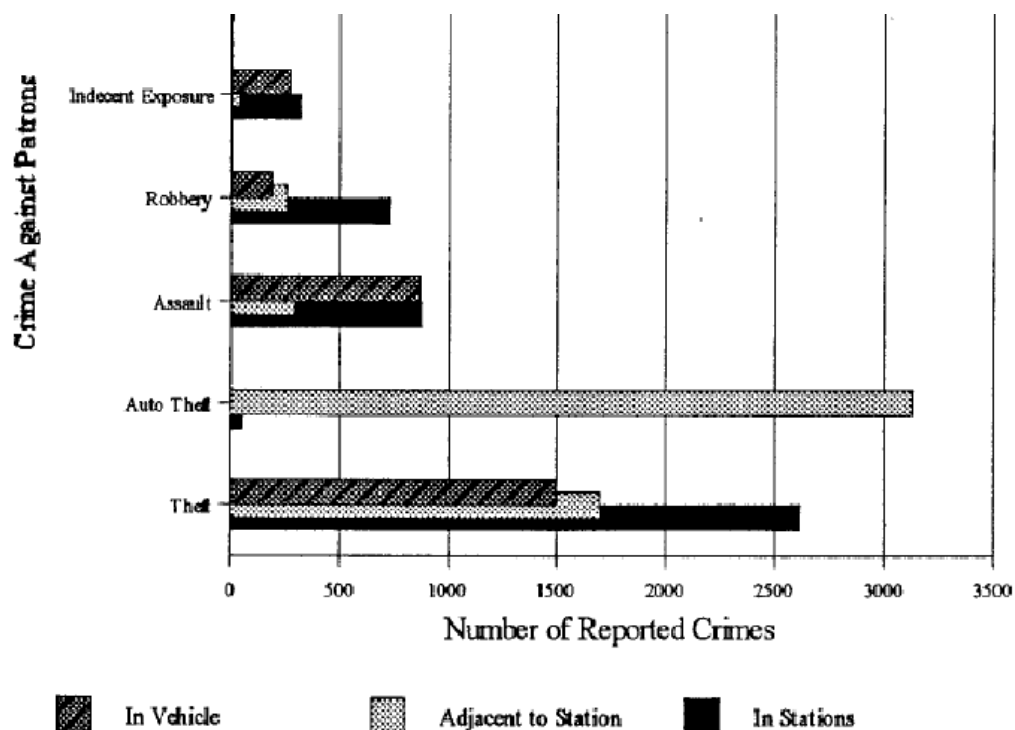
victimization are consistent with past research findings (Smith & Torstensson, 1997; Valentine, 1989; Stinger, 2007). Physical size is an uncontrollable factor and will always be a problem regarding crime because women tend to be smaller than men. Women's heightened fear of victimization on train platforms is an issue that has been supported by empirical research.

The responses of transit agencies reveal some of the masculinist tendencies within the industry. Agencies which stated women's travel behaviors make them more susceptible to attacks seem to place more blame on female passengers than is necessary. Arguably, these agencies are saying that women who choose to carry a purse and/or travel with small children on public transportation are unnecessarily putting themselves at risk, and that simply altering these travel behavior will decrease their vulnerability and fear of victimization. This rationale creates a culture of blame solely on female travelers by assuming they choose to put themselves in these particular positions. The reality is that a number of characteristics distinguish women's travel patterns and needs from that of men. Rather than asking how the transportation environment can make female passengers feel safer, these agencies are asking women to make inconvenient, and somewhat unrealistic, life changes. A number of studies have found that women's roles in society have led to a greater diversity in travel patterns compared to men. And, despite the increase of women in the workforce, they are still carrying out the majority of household responsibilities and are the primary caregivers for their immediate and extended family members. Furthermore, because a woman's economic power is generally lower than a man's, particularly in low income areas, they are more dependent on public transportation (Rosenbloom & Burns, 1993; Loukaitou-Sideris & Fink, 2009; "Gender equality scheme," 2007; Lynch & Atkins, 1988).

#### 1.4. Location of Crime

Crime statistics are useful for studying crime locations (Stinger, 2007). Knowledge about where an offense was committed and is most likely to occur next is often reliable because crime has a tendency to occur in particular areas more than others (Sherman, 1995). This information is important when trying to figure out where efforts to increase personal safety are actually needed the most. Shen, Ospina, Zhao, & Elbadrawi (1997) conducted a security analysis of 10 transit agencies in the United States from 1992-1995. Of all the 12,888 reported crimes against passengers, 42% occurred adjacent to stations/stops, 36% in the stations, and 22% in the vehicles. Figure 1 shows the number of crimes against passengers during 1992-1995 by location.

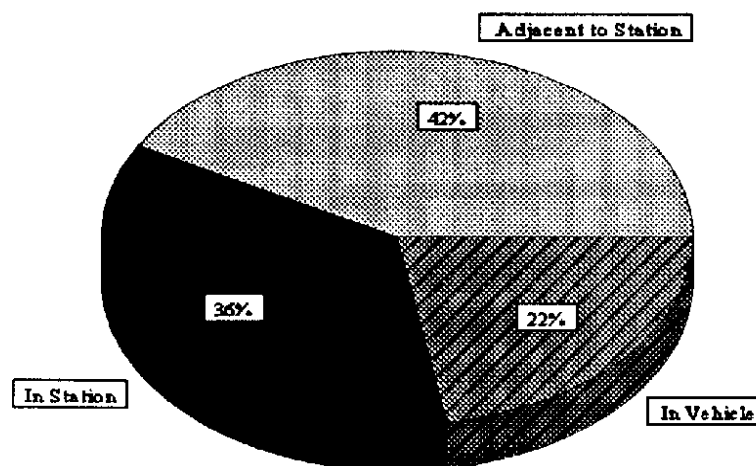
Figure 1: Number of Crimes Against Passengers During 1992-1995 in the United States



Shen, Ospina, Zhao, & Elbadrawi, 1997, p. 4

Auto theft aside, crimes against passengers “In Stations” are equal or as high as all other locations. Theft, assault, robbery, and indecent exposure were all reported to be occurring “In Stations” more than any other location. In addition, according to survey data gathered by transit agencies, crimes “In Station” had the greatest impact on passengers’ perceived levels of safety. Figure 2 shows the percentage of crimes that affect passengers’ perceived security by location. 66% of the crimes that had an effect on passengers’ perceived levels of safety occurred, “In Station” compared to 26% “In Vehicle” and 2% “Adjacent to Station.” The study shows that spaces surrounding and within train stations experience unequal levels of crime and are perceived as more dangerous by passengers accordingly.

Figure 2: Percentage of Crimes Against Passengers by Location During 1992-1995 in the United States



Shen, Ospina, Zhao, & Elbadrawi, 1997, p. 12

Valentine (1990) explored the relationship between women’s fear, use, and perception of public space. Findings were consistent with Shen, Ospina, Zhao, & Elbadrawi (1997) regarding perceptions of personal safety by location. Women interviewed by Valentine also perceived the

inside of a station as less safe. Valentine's research findings were based on 80 in depth interviews of women varying in age, lifestyle, and income from the town of Reading, England. The women claimed to anticipate themselves to be the most at risk when in spaces occupied by strangers, specifically men, whose behaviors were unregulated. Based on interviews, Valentine identified two broad types of space that are particularly frightening to women:

1. enclosed spaces with limited exit opportunities
2. deserted open spaces

According to interview respondents, these environments create opportunities for concealed and isolated attacks. Nasar and Fisher (1993) found people to be particularly fearful in similar environments, "From the perspective of potential victims, places that limit their ability to detect a potential attack in time to avoid it or get help from others would heighten feelings of vulnerability" (p. 190). And from the perspective of potential offenders, they desire an area that has places for them to hide as well as take the victim out of sight (Fisher & Nasar, 1992).

Applying Valentine (1990) and Nasar's (1993) outline of feared spaces to the public transportation realm, most underground subway station platforms meet these criteria. Depending on time of day, train platforms can be quite deserted. Station platforms are also often vast in area, with limited exit opportunities, and typically provide criminals opportunities to conceal themselves. Paradoxically, characteristics of the built environment identified by survey respondents as particularly frightening have become an important part of CPTED principles.

Consider limited exit opportunities and deserted open space. From the perspective of a potential victim, limited exits are perceived as opportunities for criminals to trap victims while deserted open spaces allow criminals to conceal themselves (Loukaitou-Sideris & Eck, 2007). The Washington DC Metro system intentionally employed CPTED strategies and is considered one of the safest, relatively "crime free" subway systems in the world, and yet its stations are

often described as “large, quiet, spacious, cavernous environments” (La Vigne, 1997; Myhre & Rosso, 1997, p. 207). According to an analysis of the Washington DC Metro system by LaVigne (1997), limited exits and large open stations were purposefully incorporated into station design. According to CPTED, limited exit opportunities are an example of “deflecting offenders” which works to increase the perceived effort of committing a crime. It also helps Metro officials monitor riders. The “cavernous environment” of the station is created by high, free-standing vaulted ceiling above the tracks, “giving the appearance of a wide-open design” (La Vigne, 1997, p. 169). This was also intentionally done to promote “natural surveillance,” another CPTED strategy, which is meant to promote the kind of supervision created by other passengers. Increasing natural surveillance is meant to add to the perceived risk of getting caught if one chooses to commit a crime.

The fact that the same characteristics of a built environment that are feared by women the most are the same architectural designs that have been purposely incorporated into the design of subway stations to deter crime is disconcerting. It also calls into question whether or not this could be a resultant of architecture being a male dominated industry. In 2007, the American Institute of Architects had only 13.3% registered female members (Ouroussoff, 2007). Built environment characteristics meant to decrease crime rates can also negatively affect passengers’ feelings of personal safety. In other words, the good intentions of the architect may be displaced by a decrease in perceived personal safety of the same riders the architect is trying to protect.

### 1.5. Current Transit Agencies’ Safety & Security Strategies

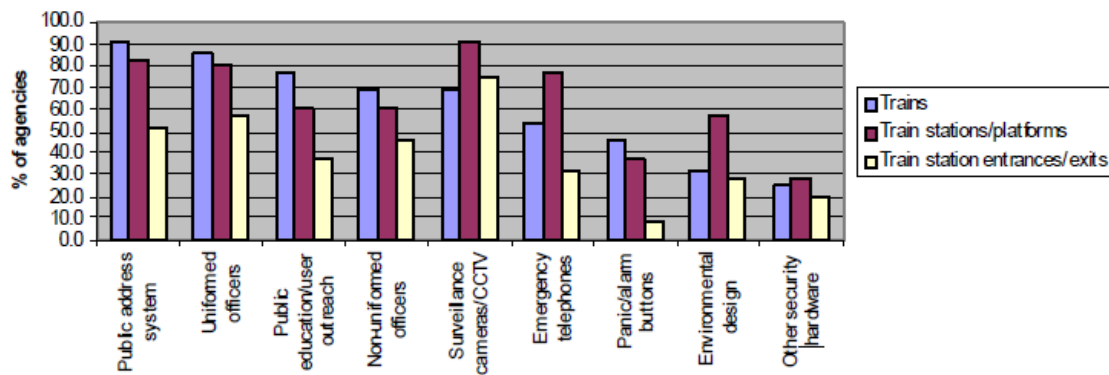
The second goal of Loukaitou-Sideris et al. study (2009) was to understand the existing safety strategies being used by U.S. transit agencies. The survey asked agencies about the safety

and security strategies in six different areas/modes of transportation: 1) buses, 2) bus stops, 3) trains (light, heavy, and commuter rail), 4) train stations and platforms, 5) train station entrances and exits, and 6) parking lots and area about stops or stations (p. 24). The specific strategies were policing, public education/user outreach, security hardware and technology, and environmental design. Transit agencies were also asked to rate the perceived effectiveness of their current security strategies. Because the present study focuses on train stations and platforms, only results concerning the train stations and platforms are discussed below.

Transit agencies reported using all four strategies – policing, public education/user outreach, security hardware and technology, and environmental design – but tended to favor specific types over others. The most commonly used strategies were security hardware and technology, namely closed circuit televisions (CCTV) and public address systems, and uniformed officer policing strategies. Figure 3 shows the various methods agencies reported using on the train cars (Trains), the platforms (Train stations/platforms), and entrances and exits (Train station entrances/exits). Though the exact percent of agencies using each strategy was not explicitly stated in the report, it is clear that the use of “environmental design” is less commonly used by transit agencies in train stations/platforms compared to other strategies. “Public address systems” and “surveillance cameras/CCTV” were among the most popular strategies on the train stations/platforms. Transit agencies seem to heavily prefer using CCTVs even though they are not singled out as particularly comforting among female riders. When asked what strategies the agency would like to use in the future, 73% stated CCTV technology, which was the most popular response, followed by 55% stating panic/alarm buttons. As far as the strategies with the highest perceived levels of effectiveness, transit agencies cited officers, both uniformed and non-uniformed, as being the most effective. The effects of gender on the relationship between police

presence and perceived personal safety are mixed. Some studies show that women prefer staffing to technological hardware while others have found significant differences (Lynch & Atkins, 1988; Loukaitou-Sideris & Fink, 2009).

Figure 3: Percent of Transit Agencies Using Each Security Method on Trains, Stations/Platforms, and Entrances/Exits



Loukaitou-Sideris & Fink, 2009, p. 27

Considering existing and future safety strategies, there is a mismatch between what transit agencies are doing and what female passengers feel is needed. Even though 87 of the 131 agencies interviewed acknowledge female passengers as having unique safety requirements compared to men, none of the agencies are even considering alternative solutions to this problem. Though empirical research findings have shown female passengers are more fearful of train stations/platforms, little has been done by transit agencies to understand exactly how to appease these fears. Furthermore, approaches to transportation security seem to be fixated on a select few strategies, with environmental design barely on the radar. Environmental design strategies, which have been successful in past studies, should be considered as more viable than they currently are.



## 1.6. Conclusion

Despite reportedly low crime statistics, fear of victimization in public transportation systems is big a problem in the United States, especially among women. Some research has been done on women's feelings of personal safety in public transportation and its consequences – changes in transportation behavior lead to reductions in train ridership and lost revenue (Hall, 1985; Valentine, 1990; Koskela & Pain, 2000; Wallance et al., 1999; Loukaitou-Sideris, 1999; Reed et al., 1999). These simple changes can have an accumulating effect on a system. There is a gap among people, academics, and practitioners regarding the level and treatment of personal safety. While it has been determined that women experience built environments differently from men, it is unclear as to what specific characteristics affect those feelings. Academics and practitioners have developed strategies that are meant to decrease crime activity but, in doing so, seem to have inadvertently created environments wherein many women feel unsafe. Meanwhile, transit agencies recognize female passengers have special needs, and yet very few policies or plans have been established to address this issue. Rather, transit agencies continue to pour money into safety and security strategies hardware that appear, at best, to have no effect on personal safety and, at worst, exacerbate fear. This is partly due to the general lack of knowledge about the specific needs, requirements and preferences of transit environment users.

This study hopes to contribute to a better understanding of the needs and preference of female passengers in public transportation stations as part of an effort to increase public transportation usage. Before an explanation of study methodology and findings (Chapter 3 and 4), this paper begins with a case study of crime in the Washington DC Metro system as reported by The Washington Post in Chapter 2. The purpose of the case study is to underscore the relevance of personal safety for women and crime in public transportation. Details of the study's

methodology and survey development are described in detail following the case study in Chapter 3. Explanations of how and why survey questions and answers were included in the questionnaire can be found. In Chapter 4, research hypotheses and findings are stated and analyzed. As will become evident, security hardware such as cameras had no main effect on female personal safety. Lastly, Chapter 5 discusses study limitations as well as policy and design implications based on the results of this project.

## CHAPTER 2

### Reporting Crime in the Washington Metro: A Case Study

#### 2.1. Introduction

This chapter is a case study of crime in the Washington DC Metro system. In regards to the larger study question at hand, this chapter provides a platform to which the relevance of female passenger personal safety is brought to light. Of course, few people would argue that personal safety is not an important issue but, perhaps, some would argue it is not a pressing one. This chapter refutes any claim that it is not a pertinent issue and research findings (to be discussed in Chapters 4 and 5), are relevant to policies being drafted today and years to come. Furthermore, this chapter validates the need for further research in this realm to be conducted by those within and outside the transportation industry.

Completed in 1977, the Washington Metro is the most modern subway system in the country and is reputed to be the safest. However, a review of a series of *Washington Post* (WP) articles on crime in the Metro indicates that we do not possess an accurate measure of the incidence of crime on Metro. This chapter first discusses Metro's questionable methods of recording and reporting crime on and near its premises. The next section describes Metro's history of incomplete crime statistics. The last two sections focus on a rise in Metro crime and the transit system's attempt to allay anxiety, including announcing its intention to hire more police and install additional security hardware. More recently, Metro has put out figures indicating a decline in various crime categories as well as overall crime on its premises, and it has claimed credit for the improvement. However, as will become clear, the improved statistics may not be an accurate indicator of the situation and will unlikely enhance the public's perception of personal safety.

## 2.2. Undocumented Crime in the Metro

Obtaining information on Metro crime has not been easy. For instance, the WP of March 19, 1999, carried a letter from Catherine Wattenberg of Monrovia, Md. to Ron Shaffer, the newspaper's "Dr. Gridlock." The piece is entitled, "Seeking Answers About Metro Crime." In the letter, Ms. Wattenberg asks "Is crime aboard the Metrorail system a secret? You would think so based on what happened to me." According to Ms. Wattenberg, she arrived at the Shady Grove Metro station just after a crime had been committed, as evidenced by the number of policemen on the scene. When she asked a policeman what had happened, he said an armed robbery had occurred. Curious about crime in the system, the following day she called the Metro police. She asked if an armed robbery had occurred, and the woman who answered asked, 'Who wants to know?' After explaining that she was a Metrorider wanting to know more information about crime in the system, her call was forwarded to media relations. The media relations representative said she didn't know anything about an armed robbery and proceeded to explain that 'crime is random.' Finally, Ms. Wattenberg spoke to the deputy chief who said that the armed robbery had taken place and that there had been a canine search. The writer concludes by posing two questions: Why is it so difficult to find out about crime on or near Metro property? And is there a single location where Metro riders can find out about crimes regardless of jurisdiction?

Shaffer's reply includes the following: "Crimes reported aboard the Metro system are a matter of public record... Metro compiles information on a broad range of crimes reported on its rail system on a monthly and yearly basis, station by station. Dr. Gridlock has obtained a copy for 1998. There were no homicides or rapes on that list, thankfully." The most common crime in

the Metrorail system is theft from parked vehicles, according to Barry McDevitt, Chief of Metro Police. He said, “Thieves most often break a window to get in...Reports of sex acts are mostly complaints of indecent exposure aboard trains. Any crime on board a train is assigned to the nearest station for reporting purposes” (Shaffer, 1999).

As noted by Shaffer, Metro’s 1998 crime report did not include any rapes but, according to the following WP article reported on May 12, 1998, there was at least one. As will be explained, crimes handled by local police, as opposed to Transit police, are not counted in Metro crime statistics. In this case, the rape had been handled by the local police since the victim had called 911 from a pay phone outside the station. The WP report on this rape shed light on Metro’s somewhat ambiguous classification of crime documentation and the lax security level at the Wheaton Metro station. An excerpt of the article, written by Alice Reid and Katherine Shaver, entitled, “Man Questioned, Freed in Wheaton Rape Case; Teen Reported Attack at Metro Station,” reads: “A report of a rape in the emergency stairwell of the Wheaton Metro station Saturday night has highlighted shortcomings with security at the Red Line station that Metro officials said they will address with a new emergency phone, possibly a camera, and tighter procedures for monitoring emergency door alarms.” The 14-year-old victim reported being dragged into a stairwell near the platform elevator and raped. Evidently, the victim fought and kicked her attacker in the groin and tried to get out of the stairwell but she found the door locked (Ruane, 1998). An alarm alerting Metro authorities to an unauthorized entry should have sounded in the station manager’s kiosk when the door to the stairwell was opened, however, officials said the alarm had gone off earlier that day and had not been reset. After the attack had occurred, the victim climbed the stairs to street level and called 911. The local police were first to arrive on the scene. The rape of the 14-year-old girl had not been included in Metro’s 1998

crime report since it was handled by the county police, despite the fact the crime was committed on Metro property.

The attack, which happened about 7:30 p.m., sent a wakeup call through the Metro system, and its officials quickly increased security, while vowing that the system was essentially safe. “Station personnel will be reminded to be more careful to monitor and reset door alarms,” according to Metro spokeswoman Leona Agouridis. Concerned about security in Wheaton’s stairwell, Metro officials “will install an emergency phone within the next two weeks,” Agouridis said. “The crime prevention unit is going to make further recommendations for better security, and those could include a camera” (Reid & Shaver, 1998; Ruane, 1998).

Incidences of undocumented rape are assumed to have continued since 1998. It was revealed in 2010 that of the four rapes on its premises during the first quarter of 2010, Metro had failed to announce two and that little was known of the other two. “Metro Waited to Announce Rape Cases; Board Chair Says Information ‘Got Lost in the Shuffle,’” is the heading of a report by Ann Tyson in the WP of April 2, 2010. Unlike assaults reported elsewhere in the Washington area, two of the crimes were not immediately made public. “Metro officials gave differing accounts of why the public was not informed about the crimes. Metro spokeswoman Cathy Asato said on Tuesday that the police deliberately withheld information on two assaults that occurred in the parking garage of Largo Town Center in February as they searched for suspects. Metro’s long-standing policy is that information is released only on a ‘case-by-case basis.’ However, Peter Benjamin, chairman of Metro’s board of directors, said information on the attacks ‘got lost in the shuffle’ during the February snowstorms. ‘I think there was an intent to inform the public,’ he said.”

In one of the attacks which took place on February 5, 2010, a woman had been raped at gunpoint in the station parking lot and her vehicle taken. When the vehicle was located and the assailant apprehended a few days later, he was found in the company of a 13-year-old girl who had been reportedly kidnapped a few days before.

The reaction from passengers using the Largo Town Center Station was upset and concerned, as expected. “They should at least make people aware so they could have someone walk them to their car,” Metrorider Linda White-Ballou said. She said that when she used to work late downtown, the garage made her nervous. “You’d come in and nobody was around,” she said. Another fellow female rider agreed with her, “Of course that’s information we should have.” She went on to say that she would like to ride Metro to evening events more often but she is afraid because of the lack of security at the parking garage, “They need someone patrolling.” However, according to Lisa Farbstein, a Metro spokeswoman, said police regularly patrol the Largo garage and those at other stations and security cameras also are used.

The final paragraph of Tyson’s 2010 article closed with some shocking crime statistics; its source was unspecified. “Robberies in the Metro system have surged steadily from 349 in 2005 to 849 last year, statistics show. Of the more than 2,032 crimes carried out in the Metro system last year, about half, or 975, took place in the rail system, and another half, 819, in parking lots and garages, while far fewer, 118, took place on buses, according to Metro crime statistics.” As will be revealed in the next section, actual crime figures appear to have been at least 20% higher than what Metro crime statistics report (Sun & Layton, 2005).

Although these arguably may appear to be isolated instances of crime being misrepresented by Metro, it is safe to assume that these are not the only times. In both examples discussed above, the conditions in which the rapes occurred were not exceptional in any way. In

the case of the 14-year-old girl, the attack took place close to the train platform in the early evening hours, a time and a place many passengers find themselves during the evening rushmore. The fact the victim reported the attack from a pay phone off of Metro property and the local police were the first to respond, does not justify the classification of the crime as anything but a Metro crime. What is more, withholding information from the public concerning crime on the Metro seemed to only further agitate the personal safety of riders. It is safe to assume serious crimes such as rape, crimes particularly important to women, have gone undocumented in the Metro crime report in the past. By doing so, Metro is not being transparent about the possibility of crime in and around the stations and does its customers a great disservice by failing to encourage people to be proactive about their safety by taking additional precautionary measures.

### 2.3. Incomplete Metro Crime Statistics

“At Metro, Some Crimes Don’t Count; Statistics Exclude Incidents Handled by Local Police Department,” is the title of a front page report by Lena Sun and Lyndsey Layton in the WP issue of November 20, 2005. According to the reporters, Metro transit officials were guilty of undercounting dozens of assaults, robberies and other major incidents off the official tally they report to the system's board of directors and the public. This comes as a result of a long-standing policy not to count crimes handled by law enforcement officers other than Metro's Transit Police, even if the crimes occur in a station or on a subway platform. An example of such occurred in the case of the 14-year-old rape. The article goes into detail about how much this policy effects crime statistics. For the 18 months ending in June 2005, for example, Transit Police recorded 73 aggravated assaults at rail stations, but they did not include the 21 aggravated assaults reported by other police departments which brings the total up by nearly 30 percent.



Surprisingly, nearly 60 percent of the serious crimes at Montgomery County stations did not show up in Metro figures because they were investigated by local police.

These skewed numbers really brought about serious criticism about Metro's bookkeeping methods and its claim that crime had fallen. "In a July news release, Transit Police Chief Polly Hanson boasted of a 24 percent reduction in aggravated assaults and a 19 percent drop in larcenies between June 2004 and June 2005. According to the department's 2004 annual report, a larger category of crime on the rail and bus system dropped by 2 percent compared with the previous year – 1,234 crimes compared with 1,259." However, during the 18-month period reviewed by Sun and Layton, Metro counted 463 serious crimes at its rail stations while 98 other, similar incidents remained off its books. This information was according to local police department records. When included, it raises the total number of serious crimes – rapes, aggravated assaults, armed holdups, pickpockets, and purse snatches – by more than 20 percent. At the Rockville station, for example, county police handled eight robberies and two aggravated assaults, and Transit Police reported just one aggravated assault. At the Columbia Heights Station in Northwest Washington, D.C. police reported 14 robberies and one aggravated assault. Metro reported seven serious crimes. Many of the most serious incidents, however, were not counted in Metro statistics.

With 50,000 parking spots at the Metro stations, car theft also remains a major problem. Transit Police Chief Polly Hanson boasted that the number of stolen cars parked on Metro property had dropped 40 percent compared to 2004. However, once more, she did not include incidents handled by other jurisdictions. In the 18 months leading up to June 2005, Metro recorded 349 car thefts or attempted thefts. But other police departments reported an additional 50 thefts or attempted thefts, an additional 14 percent.

Despite its reputation for safety and its under reported crime, in 2005 the Washington Metro did not compare well with other transit systems. “Officials in charge of the nation's second-busiest subway system, behind New York's, have long placed a premium on its image as a safe, secure system, boasting about low crime rates as ridership has soared to record levels” (Sun & Layton, 2005). Reported in crimes per million trips, Metro reported its crime rate in 2005 as 6 crimes per 1 million trips, compared to 1.72 for the Bay Area Rapid Transit rail system in San Francisco Bay and the 1.1 rate reported by New Jersey Transit. Metro transit officers. Of course, other transit agencies may be engaging in the same procedure as Metro; deciding at the scene of the crime which police agency, local or transit, will take the lead role and book the crime. It is hard to make any concrete conclusions about crime in public transit given the numerous examples of Metro failing to take responsibility or properly document crime occurring on Metro property.

#### 2.4. Metro's Response to Rising Crime

There was a surge in Metro crime from 2005-2010. “Serious Crime on Metro Hits 5-Year High,” is the title of a front page report by Ann Scott Tyson in the WP on February 24, 2011. According to the article, serious crime increased by 12 percent in 2010. This was largely caused by a sharp rise in the number of aggravated assaults and robberies by thieves who snatch smartphones, MP3 players and other electronic devices. In 2006, 1,440 serious crimes were reported compared to 2,279 in 2010; that marks a five-year high. Between 2009 to 2010, aggravated assaults rose from 94 to 136 and the number of rapes increased from one to seven. This trend was not unique to the Metro system as Tyson reports, “Transit officials said that other systems are experiencing increases in serious crimes – including

homicide, rape, robbery, aggravated assault, burglary, larceny and motor vehicle theft.” Even so, New York City's subway system which has more daily riders compared to Metro have roughly comparable crime numbers.

Given the small police force charged with covering a 1,500-square-mile transit zone in DC, Maryland, and Virginia, Metro officials say they have no choice but to react to the crimes. However, as a proactive approach to crime prevention, Metro Transit Police began deploying “‘robbery suppression teams' in which plainclothes officers display fake iPods and other devices in an effort to entice would-be robbers, Transit Police Deputy Chief Ronald Pavlik said. The teams have made dozens of arrests in the past year.”

The trend of rising Metro crime is believed to be partly caused by a displacement of street-level crime. In a report by Dana Hedgpeth in the WP entitled “Metro Needs More Officers to Deal with Crimes on Trains, Officials Say,” the displacement of crime into the Metro stations is discussed. “We've been really successful driving crime down in the city, but our success is creating problems for Metro,” D.C Police Chief Cathy L. Lanier said. “They're going to the easiest place to carry on with crimes and get away... We push them off the above ground public space and they go down into the train.” It was unanimously agreed that the system needs more cops to monitor the activity in and around the stations. According to officials, Metro's fiscal 2012 budget calls for the system to hire 30 police officers for its “special police division,” which has 153 officers who monitor rail and bus yards and other Metro facilities. Hiring additional officers in that unit will “free up” 15 to 30 officers to patrol Metro's bus and rail systems. Before adding more cops, Metro planned to install new CCTVs in its 83 stations.

Ann Tyson in the WP of March 25, 2011, describes the measures Metro intended to take in an article entitled “Metro to Install Security Cameras at Station Entrances.” The article states

that the planned 153 security cameras will allow police to monitor station exits 24 hours a day, capture evidence of crimes, and manage crowds. These cameras, to be funded by a \$2.8 million grant from the Department of Homeland Security, would be the first to film the exteriors of the Metro stations and part of a larger anti-crime campaign. The writer notes that by installing CCTVs, Metro was following the other major rail systems including New York, Los Angeles, Chicago, New Jersey, Atlanta and Boston. Transit Police Chief Michael C. Taborn also wanted to create an auxiliary police force to supplement Metro's 450-member police force. As admitted by Taborn, Metro police was stretched thin across Metro's rail and bus network. He adds: "There is more need than there are officers available to patrol the system" (Tyson, 2011). It is noteworthy that in 2009 a similar push was made to install CCTVs around the system, costing approximately \$7.1 million to be funded by the Department of Homeland of Security (Hohmann, 2009). Evidently, nothing had come of it. At the time of this writing (June 2012), there is no indication that additional police have been hired nor the cameras installed. Based on the lack of action, fighting crime on Metro does not appear to be a high priority. There is every indication that the above findings for the Washington Metro are also applicable to the other large city transit systems.

## 2.5. Reported Decline in Metro Crime

In 2005, as above noted, Metro had announced a decline in crime from 2004. It was pointed out that the "decline" was fictitious and that actual violent crime was at least 20% higher than reported. In some localities, actual crime was 60% higher than indicated by Metro figures (Sun & Layton, 2005). In a manner reminiscent of 2005, late 2011, Metro reported that, thanks to its measures, crime fell during the second half of 2011. "Major Crime on Metro Falls in 3<sup>rd</sup>

Quarter,” reports Dana Hedgepeth in the WP of December 14, 2011. Metro Transit Police attributed the decline in crime to a computerized system, Metrostat, used to track crimes, more strategic patrolling, and the launching of more public awareness campaigns. Metrostat which enables transit police to determine crime trends and deploy resources accordingly, was credited for much of the decline. According to Metro's statistics, 4.75 crimes occurred per million riders in the third quarter of 2011, compared with 6.02 in the third quarter of 2010. In Metro parking lots, crime dropped to 3.07 per million riders from 4.07 million. For the quarter, larceny from vehicles was down to 94 incidents from 100, and auto thefts and attempts fell to 38 from 59. Armed robberies fell from 11 to four, and the number of robberies in which customers did not see a weapon fell to 73 from 97. There were 25 aggravated assaults for the quarter, down from 43 for the same period last year. Police also made 1,922 arrests in 2011, fewer than the 2,008 made the year before (Hedgpeth, 2012). Transit Police Chief Michael Taborn said the number of arrests was down because he has dispatched more police officers, including 20 from an anti-terrorism unit, throughout the system. Metro also planned to hire 50 more officers. “If we're more visible, we discourage people from committing crimes,” he said. Even so, Taborn is hesitant to boast about the statistics as “there is no indication if these figures include crimes handled by other police jurisdictions, it is possible that, similar to 2005, the supposed “decline” could conceal a worsening crime situation.”

## 2.6. Conclusion

In closing, the Washington Metro has been successful in propagating an image of a safe and secure transit system than reality. This has been done by, first, putting out incomplete statistics by solely reporting on crime handled by the Metro Transit Police. In fairness to Metro,

it is not the only transit system that only reports crimes dealt with exclusively by its own transit police. Secondly, much of its reporting has consisted of publishing macro-level, aggregate crime data which show falling crime per million users. As noted, these encouraging statistics are unlikely to reassure those apprehensive Metro users who are exposed to frequent media reports of serious crime on Metro. Clearly, Metro must not only take additional measures to increase safety and alleviate fear but also consider alternative methods. The reliance on crime statistics and security hardware as a means of improving personal safety has proven to be a poor use of time and resources. Rather than assuming security hardware's capability of reducing and alleviating fear of victimization, it would be more effective to begin by understanding the needs of its passengers so that resources, whether monetary or other, can be used efficiently. The following chapters describe the study methodology, findings, implications, and recommendations regarding personal safety in transportation stations.

## CHAPTER 3

### Methodology & Survey Development

#### 3.1. Methodology

This study utilizes original data collected from an online survey in April 2012. 250 people from Cornell University's Johnson School of Business and School of Law list-serves were invited via email to participate in the study. The list-serves comprised of students and faculty members living both within the United States and abroad. The email contained study objectives and a link to the survey. Before beginning the survey, participants had to read and agree to a consent form. There was no incentive or compensation given to participants for participating. Because participants were not randomly selected, self-selection bias is one of the study's major limitations. This and other study limitations are discussed in greater detail in Chapter 5.

A total of 160 participants completed the survey (64% response rate). 57% of the participants were female and 74% of all participants fell between the ages of 18-33. 57% of participants had earned a graduate or professional degree and 37 % had received a college degree. Just over half of respondents (51%) said they had not used metro/subway/underground at all in the past month, followed by 16% saying they had used it less than once a week and another 16% saying they had used it every day. According to 2009 U.S. Census Bureau data, approximately 5% of all Americans use public transportation to commute to work, 1.7% of which cited using "Subway or elevated train" (McKenzie & Rapino, 2011). Considering the general infrequent usage of subway systems in the United States and the high frequency of usage among survey participants, this sample is not representative of the general population.

33% of respondents said they have avoided using the subway/metro/train because they did not feel safe. 'Traveling alone' and 'time of day' were the most common reasons for not feeling safe, both 81% respectively. 36% of respondents said a 'potential long wait at the station' was also a reason to avoid travel.

### 3.2. Survey Development

Survey questions were developed using a combination of existing theories and previously used methodology. The survey is divided into four distinct categories of interest: demographics, safety and travel behavior, security measures, and train platform analysis. In the following section, each category and relevant questions and answers are discussed. A copy of the complete survey which may serve as a guide while going through this section can be found in Appendix 2 of this document.

#### 3.2.1. Demographics

Participant demographics were collected to determine whether perceptions of the built environment differed by gender, age, education, and frequency of transportation use. The rationale behind focusing on these particular demographic characteristics is discussed below.

Research has found gender and age to be reliable predictors of gauging fear of victimization (Lynch & Atkin, 1988; Schulz & Gilbert, 1996). As has been discussed in previous sections, female riders tend show higher levels of fear. The main argument for this is that it is socially acceptable and encouraged for women to express emotions, including fear. Men, in an effort to maintain a perception of strength and masculinity, may suppress or limit fear (Sutton & Farrall, 2005). Men cite their gender, size, and strength, as things that help them feel safe



(Tulloch, 2000). However, there is a belief that men's fear may have been understated in the past (Crawford et al. 1990). Despite this theory, the weight of evidence clearly signifies that women have a higher fear of crime in public transportation. It has been commonly believed that age increases fear of victimization. Typically, elderly men and women were thought of as 'prisoners of fear' because of their inability to physically defend themselves (Rowles, 1978; Pain, 2000). People are now beginning to deconstruct this image of older people as unquestionably fearful and realize that fear of crime in old age is greatly influenced by experiences earlier in life as opposed to chronological category (Pain, 1995).

Generally, there is a strong positive correlation between level of education and economic status. Research on economic status and perceptions of safety find that women with lower economic resources are likely to be more constrained by security fears. The safest modes of transportation are perceived as cars and taxis, which are less accessible to economically restricted individuals. Poor people are, therefore, more reliant on modes of transportation that are perceived as less safe. On the other hand, levels of fear also differ between frequent and infrequent travelers (Lynch & Atkins, 1988). In general, as frequency of use rises, level of fear decreases, and vice versa. Survey respondents were asked, "In the past month, approximately how frequently did you use the metro/subway/underground?" In this survey, "frequent users" were defined as respondents who reported using the metro/subway/underground "once a week," "more than once a week," or "every day in the past month." "Infrequent users" answered "less than once a week," or "did not use it at all."

### 3.2.2. Safety and Travel Behavior

Respondents who answered ‘Yes’ to the question “In the United States, do you ever avoid using the metro/subway/underground because you don’t feel safe?” were asked a follow up question to describe why they do not feel safe (see Appendix 2). This was done in order to better understand the rationale behind changes in travel behavior. Understanding the primary reasons behind avoidance could lead to better, more focused security strategies. Respondents were given the following options and encouraged to select all answers that applied: traveling alone; previous personal negative experience(s) when using public transportation; potentially long wait time at the station; time of day; recent negative event(s)/report(s) concerning public transportation safety; traveling to/from the station. Respondents also had the option to write in their own response. Justification of some of the answer choices is discussed below.

Clarke (2003) found that those who have been victims of crime in the past demonstrate higher levels of fear in transit environments. This effect is especially true among females. When comparing fear of victimization in men and women who had suffered similar criminal experiences, women had higher levels of fear of victimization (Skogan & Maxfield, 1981). Women who have had personal negative experiences are more likely to generalize that experience across time and space (Warr, 1984).

The idea of a long wait at a subway station is enough to deter transit use. This is not solely due to the inconvenience caused by a wait, but also due to the perceived risk that an extended wait can bring about. In places where sightlines are obstructed with few exit opportunities, fear of attack while waiting is heightened (Zelinka & Brennan, 2001). These feelings are particularly heightened among women. In a survey conducted by the British Department for Transport in 2004, 61% of female passengers reported feeling unsafe while

“waiting on underground station platforms” at night compared to 32% of men. Interestingly, “waiting on underground station platforms” was considered the least safe place among men. Also the same study reported that 59% of women felt unsafe when “walking to bus station or stop”, and 48% experienced fear when “walking from bus station or stop”. The respective figures for men was 20% and 25%. (Department for Transport, 2004).

Public transportation crime statistics consistently show low rates of reported crime against passengers. And yet women still have high rates of fear of victimization within these spaces, particularly in the form of sexual violence and harassment from men (Loukaitou-Sideris et al, 2009; Bennett, 1990; Schulz & Gilbert, 1996). Many feminist scholars attribute women’s fear of crime to society’s portrayal of women as vulnerable and ‘born victims’ (Hanmer and Saunders, 1984; Pain, 1991; Valentine, 1989). In other words, women have been programmed to view themselves as helpless targets of crime by a variety of sources – from the media to police warnings to crime prevention courses specifically for women: “Ideologies and images of sexual danger, supported by media, rumor, first-hand experience and warnings from others, have a role in constructing fear in public space” (Pain, 2000, p. 374). As a result, the area in which violence towards women is most likely to occur (the private realm) is understated, and the real amount of threat women face in the public realm is overemphasized. Finally, perceptions of safety change depending on the time of day. Traveling during evening and nighttime hours is considered to be less safe than traveling during the day. This is due to the difficulty of effective surveillance by travelers and to the reduced presence of other passengers.

### 3.2.3. Security Measures

All respondents were asked to rank eight characteristics from 1 to 8, where 1 is “the most important to my personal safety” 2 is “the second most important to my personal safety,” and so on (See Appendix 2). The purpose of this question was to determine if respondents’ and transit agencies prioritize the same security measures. Respondents were asked to rank: lighting, digital wait time clocks, emergency phones, system announcements, visible security cameras, visible security television monitors, entrance/exit signs, and other passengers. These characteristics were chosen based on past research concentrating on security in public transportation as well as security in other realms. Significance and rationale behind choosing each component is discussed below.

Lighting and its effect on personal safety and crime has been the focus of numerous studies (Atkins, Husain & Storey, 1991; La Vigne, 1997; Koskela & Pain, 2000). Interestingly, people do not always associate well lit areas with increased feelings of personal safety because well-lit areas may actually make it easier for criminals to see them (Atkins, Husain & Storey, 1991). On the other hand, there are those that feel poorly lit areas makes it more difficult for them to monitor their surroundings, making it easier for a criminal to attack. Either way, lighting, too much or too little, is an important part of personal safety and security.

Female passengers consider having to wait for trains on subway platforms to be one of the least safe places (Department for Transport, 2004). Digital wait time clocks (DWTC) can be useful in avoiding long waits on the subway platform as well as decreasing vulnerability. Interestingly, it appears as though these clocks are popular among passengers primarily because they aid in estimating travel time (Loukaitou-Sideris & Fink, 2009). However, their role as a

crime prevention tool or effects on perceived personal safety is either unknown or undocumented among riders.

Emergency phones, also known as Blue Light telephones, are a popular form of formal reporting and surveillance found in a wide variety of environments, from university campuses to transportation stations (Day, 1995; La Vigne, 1997). These phones are meant to be used in the event of an emergency. With the push of a single button, a user is connected to authorities who are able to respond to the situation appropriately (Wallace, Rodriguez, White & Levine, 1999). Like other forms of security hardware, their presence is appreciated, or expected, but the effect on personal safety is unclear. Also considered a type of formal surveillance, system announcements are supposed to increase a criminal's perceived risk of getting caught (Myhre & Rosso, 1997). It is unclear how effective this strategy actually is or how passengers feel about them.

There has been extensive research surrounding closed-circuit televisions (CCTV) and its effect on passengers' feelings of security. According to Nancy LaVigne (1997, p. 174), "Cameras are purposefully visible to riders to bolster feelings of safety, as well as to alert potential criminals that they are being monitored." However, this description may simply be more of an idealized description of their purpose rather than a realistic one. In a telephone interview, the former chief of Metropolitan Transit Police stated "The cameras mainly serve a psychological purpose because they read out at the station manager's kiosk, and often no one is there" (MacLean, 1995). Riders identify CCTVs as proactive security measures that are useful in identifying a criminal after the crime has occurred, but less helpful when the crime is actually taking place (Yavuz & Welch, 2010). Females are particularly unconvinced about the effectiveness of CCTVs. In a study of female transit passengers' reaction to newly implemented

safety measures in Ann Arbor, Michigan, CCTV cameras had no significant impact on the respondents' feelings of safety (Wallace, Rodriguez, White & Levine, 1999). According to female participants in a focus group, "[they] do not feel more secure in the knowledge that someone, somewhere is supposed to be watching them." (Trench, Tanner & Tiesdell, 1992, p. 291) While CCTVs may rank highly among security characteristics for both males and females, it is hypothesized that CCTVs will be considered less important for females.

The effect of visible security television monitors has only been studied in relation to crime reduction in a retail environment. The presence of these monitors is considered a type of formal surveillance tactic and is meant to add to a criminal's perceived risk of apprehension. While they have been proven to reduce robbery rates, the effect on patron safety has never been measured (Eck, 2004). Signage clearly indicating station entrances and exits help passengers navigate the space quickly and with a minimum of wandering around. Similar to digital time wait clocks, it is unclear if passengers associate entrance and exit signage with personal safety.

Finally, the presence of other passengers can either be comforting or threatening to another passenger. Those who find them to be comforting think of them as informal watchdogs. As a form of natural surveillance, their presence can increase a criminal's perceived risk of being caught since other people may be witness to the incident. In addition, women described "deserted open spaces," void of other people, as environments they fear the most (Valentine, 1990). At the same time, other passengers may be interpreted as potential threats to a passenger's safety. Subway platforms are available to anyone who pays and, sometimes, for those who do not pay. It is a shared public space where the behavior of another passenger is relatively unpredictable and uncontrollable (Smith & Clarke, 2000). This type of atmosphere can lend itself to a positive relationship between number of other people and fear of crime.

### 3.3. Train Platform Analysis

To test for a moderating effect of gender on perceptions of transportation environments, survey participants were asked to rate their level of satisfaction of four out of twelve randomly selected photos using a Likert-scale. The Likert-scale questionnaire had a cronbach alpha reliability coefficient of 0.68 which indicates a modest reliability. The scale was a satisfaction rating from 1 to 5, where 1 was considered “Very unsatisfied” and 5 was considered “Very satisfied.” Participants were asked to rate their satisfaction with each photo regarding the overall sense of personal safety, sightlines, and security hardware. Sightlines were defined as the “ability to see what’s ahead” and security hardware was defined as “nonhuman technology such as cameras and emergency phones.”

Two photos from Washington DC (Metro), Chicago (L), and New York City (NYC) subway systems were used in the survey. Each photograph was taken from the perspective of a passenger’s first glimpse of the platform. This shot was meant to mimic a passenger’s first impressions, which have been shown often to influence how information is interpreted later (Tetlock, 1983). In general, the design of transportation stations, such as lighting levels, signage, and color, are uniform across a system to make the system more recognizable and easier to use (La Vigne, 1997). For added variability among the photos used, one photo was a “split platform” design and the other a “shared platform.” A split platform has passengers traveling in opposite directions located on separate platforms. A shared platform design has passengers traveling in opposite directions sharing a single platform. (See Images 1 & 2). To test for a moderating effect of DWTC on perceptions of train platforms, DWTC were added to each photo using Photoshop. Therefore, there existed two different versions of the same station: one with DWTC and one

without a DWTC (No DWTC). Appendix 1 provides a description of all twelve photos used in the survey.



Image 1:  
“Split platform” Design, L (Chicago)



Image 2:  
“Shared platform” Design, L (Chicago)

This section will begin with an analysis of the platform designs, grounded in CPTED theory and research. And then, based on these analyzes, hypotheses will be developed regarding gender differences in rating satisfaction with: overall sense of personal safety, sightlines, and security hardware.

### 3.3.1. Analysis of the Washington DC Metro Platforms

Photos of the Bethesda (shared) and Dupont Circle (split) station platforms were used in the survey (see Appendix 1). Nancy La Vigne (1997) did a detailed analysis of the design of the Washington DC Metro system which has crime prevention techniques “built into” the original design. Addressing the issue of security and safety through the built environment, as opposed to the social environment, from its inception is a concept unique to the Metro system. Relative to the New York City and Chicago systems, Metro was a newer system whose design coincided



with the introduction of CPTED. Also, Metro planners were able to draw on years of experience in security issues seen in mass transit systems domestically and around the world. (La Vigne, 1997) Therefore, it is important to note that the following analysis and discussion of the Metro platforms, compared to that of the 'L' or NYC Subway systems, is more focused on crime prevention techniques because it was designed with crime prevention and safety in mind.

The Metro platforms were designed to increase riders' perceptions of safety by ensuring uncrowded stations and maximizing sightlines. To minimize crowding, platforms are particularly wide, approximately 60 feet wide. To increase sightlines platforms have high, freestanding vaulted ceilings that have the minimal number of supporting columns. This creates a "spacious, cavernous environments" which supposedly offers very few places for criminals to hide (Myhre & Rosso, 1997, p. 207). Furthermore, creating overhead crossovers as pathways, a CTPED strategy known as natural surveillance, to connecting lines and platform exit/entrances, as opposed to long passage ways, gives riders additional opportunities to survey platform activity.

### 3.3.2. Analysis of the Chicago 'L' & NYC Subway Platforms

The Chicago 'L' and NYC Subway systems are the two oldest rapid transit systems in the United States. The 'L' began operating in 1892 and the NYC Subway in 1860. The two systems are similar in platform design; both having long straight platforms, supported by numerous columns. Because they were built before the potential of the physical environment as a crime fighting tool was realized, the platforms have very few crime prevention techniques incorporated. Unfortunately, it would be nearly impossible to make major changes to the design of these platforms because they rely heavily on supporting columns which cannot be removed. (Kelling & Bratt, 1998) The design of the platforms lend themselves so strongly to criminal

behavior that the only way to properly address it is through the social environment. In a 1998 study of the recently reduced crime rates in New York City, George Kelling and William Bratt attributed the reduction in subway crime almost entirely to the work and intervention of the Transit Police Department. Though they did mention that restoring order was an important aspect of the system's improvement, they also added that "action by the TPD achieved a 'tipping point'" (p. 1224). In other words, police presence, a CPTED strategy known as formal surveillance, was the catalyst to the most crucial changes in the system. Today, maintenance upkeep still plays an important role in the success of the New York City subway system but changes in the social environment are what have sustained its longevity.

Photos used for the 'L' were taken at the Grand/Milwaukee station which had both split and shared platforms. Photos used for the NYC Subway were taken at the West 4<sup>th</sup> Street and Greenpoint Avenue stations.

## CHAPTER 4

### Results & Discussion

#### 4.1. Intercorrelations

Table 1 provides incorrelations between gender, age, education, frequency of use, and overall personal safety score. It comes as no surprise that age and education are highly correlated (p-value = 0.000). As an individual's age increases, they are also more likely to have earned degrees in higher education. This is especially true among this sample of participants as their level of education was quite high.

Overall personal safety score and gender were also significantly correlated (p-value=0.002). This relationship supports previous research findings that women are more likely to feel less safe in an environment compared to men.

Table 1: Correlations of Gender, Age, Education, Frequency of Use & Overall Personal Safety Score

	Gender	Age	Education	Frequency of Use
Age	0.018 0.825			
Education	0.116 0.146	0.299 0.000*		
Frequency of Use	-0.060 0.450	-0.061 0.442	0.002 0.984	
Overall Personal Safety	-0.249 0.002*	0.140 0.078	-0.014 0.858	-0.150 0.058

\*p<0.05

This study attempts to gain a better understanding of how people perceive CPTED design used on subway platforms by asking respondents to rank order elements of the built environment generally associated with safety and security. To this end, several hypotheses on the relationship between perceptions of personal safety and the built environment were tested. The hypotheses fall under the following topics: overall sense of personal safety, sightlines, and security hardware.

#### 4.2. Overall Sense of Personal Safety

Nancy La Vigne's (1997) study of crime in the Washington DC Metro system concluded that its reported low crime rate can be explained by its environment – the way the system is designed, managed, and maintained. At the same time, its “cavernous” design could be considered the antithesis of a safe environment, especially for women. With these two considerations in mind, the following three hypotheses were tested:

*H1a: Female participants will be the less satisfied with the overall sense of personal safety compared to male participants.*

*H1b: Survey participants will be the most satisfied with the overall sense of personal safety of the Metro system compared to the L and NYC Subway.*

*H1c: Female participants will be less satisfied with their overall sense of personal safety of the Metro system compared to male participants.*

Three 2 sample t-test with 159 degrees of freedom were performed to test for a difference in overall personal safety score between female and male participant (H1a). Differences in personal safety satisfaction score by gender were not statistically significant at the 0.05 level (p-value = 0.64 > 0.05). This study found no differences in personal safety scores between females and males.

*H1b: Survey participants will be the most satisfied with the overall sense of personal safety of the Metro system compared to the L and NYC Subway.*

To test for a difference in overall personal safety ratings across the three systems, 95% confidence levels of mean scores across all three systems were initially calculated. The sample size ( $n=93$ ) included only respondents who were asked to rate at least one photo from each system. This was done to control for participant and location effect in the analysis. Based on this analysis and the calculation of 95% confidence intervals, we are 95% confident that the true mean score of overall personal safety in the L and NYC Subway systems fall between [3.39, 3.75] and [3.27, 3.63], respectively. The overlap in L and NYC Subway confidence intervals is sufficient evidence to conclude there is no difference in mean personal safety scores between the two systems. However, the 95% confidence interval of the Metro [3.87, 4.26] is above and outside the range of both L and NYC scores.

A pooled 2 sample t-test with 184 degrees of freedom was performed to test for significant differences in overall personal safety scores in Metro versus L and Metro versus NYC. Differences in personal safety satisfaction score in the Metro system compared to both L and NYC were statistically significant at the 0.05 level ( $p\text{-value} = 0.00 < 0.05$ ). Based on this data set, we are able to conclude that survey participants were the most satisfied with the overall sense of personal safety of the Metro system compared to the L and NYC Subway.

*H1c: Female participants will be less satisfied with their overall sense of personal safety of the Metro system compared to male participants.*

A 2 sample t-test with 133 degrees of freedom was performed to test for a difference in means between female and male participants in overall sense of personal safety in the Washington DC Metro system. Results of the test of means and 95% confidence interval show a statistically significant difference in ratings between men and women ( $p\text{-value} = 0.035 < 0.05$ , 95% CI [0.027, 0.711]).

To further investigate the relationship between gender and the perception of overall personal safety, an ordinary least squares (OLS) regression was performed to test for a linear relationship in the Metro system. The explanatory variable Gender was introduced as the predictor variable. Results of OLS regression indicate that Gender has a main effect on personal safety scores within the Metro system,  $b_1 = -0.369$ ,  $p\text{-value} = .041 < .05$ ,  $R^2_{\text{adjusted}} = 2.3\%$ . This regression analysis suggests a negative correlation between gender and overall sense of personal safety. In other words, female passengers, on average, are less satisfied with the overall sense of safety of the Metro system than men. Conducting a stepwise regression to test for effects of Age, Education, and Frequency of Use on personal safety revealed no other significant effects on personal safety scores.

Digital wait time clocks (DWTC) not only provide riders information regarding their trip but they could also potentially increase feelings of personal safety. People experiencing unexpectedly long waits on train platforms are likely to experience an increased fear of victimization as well. These feelings are particularly high among women. (Department for Transport, 2004) Therefore, the following two hypotheses on the effect of digital wait time clocks on overall feelings of personal safety were tested:

*H2a: Participants will be more satisfied with their overall sense of personal safety with photos with digital wait time clocks than without digital wait time clocks.*

*H2b: Female participants will be more satisfied with their overall sense of personal safety than male participants in the presence of digital wait time clocks.*

A 2-sample t-test with 306 degrees of freedom was performed to test for a difference in overall safety between photos with digital wait time clocks (DWTC) and without digital wait time clocks (No DWTC) (H2a). Photos with a DWTC had an average overall safety score of 3.84 compared to 3.71 for No DWTC photos. However, testing revealed no significant differences in participant scores at the 0.05 level ( $T\text{-value} = -1.34$ ,  $p\text{-value} = 0.181 > 0.05$ ).

*H2b: Female participants will be more satisfied with their overall sense of personal safety with photos with digital wait time clocks than male participants.*

A 2-sample t-test with 130 degrees of freedom was performed to test for a difference in means in overall personal safety scores of women versus men for photos with DWTC. Male participants were more satisfied with their personal safety when rating photos with DTWC compared to female participants. The average personal safety satisfaction score for women was approximately 3.82 and the average score for male participants was 3.88. Moreover, since the confidence interval contains zero, the null hypothesis cannot be rejected. The test revealed there were no effect of gender on personal safety scores ( $p\text{-value}=0.656>0.05$ ).

These findings were further validated when an OLS regression was performed to test for a gender and DWTC interaction. Gender ( $b_1$ ) and DWTC ( $b_2$ ) were both indicator variables and average personal safety score was the dependent variable. A two-tailed t-test on the DWTC coefficient helped decide whether the difference in score between males and females is large enough to be considered statistically significant. The coefficient values were not statistically significant, namely DWTC ( $b_2$   $p\text{-value} = 0.77 > 0.05$ ). There is not enough evidence to conclude that the average personal safety score for males is different than females after taking DWTC into account.

#### 4.3. Sightlines

Open sightlines are believed to be important to rider's conception of personal safety as well as crime prevention (Yavuz & Welch, 2010). Women are especially sensitive and aware of environments that provide opportunities to hide. Because Metro was designed with this specific

feature in mind, it is assumed participants will be more satisfied with Metro than L or the NYC system sightlines (La Vigne, 1997). For these reason, hypotheses were developed:

*H3: Female participants will be less satisfied with L and NYC Subway sightlines than male participants.*

A two-sample t-test with 18 degrees of freedom was performed to test for a difference in mean scores in sightline satisfaction scores between men and women in the L and NYC systems. Participants who rated one or two photo from each system were included in the analysis, hence the reduced sample size. Using a critical value of  $\alpha=0.05$ , we fail to reject the null hypothesis that there is a difference in mean satisfaction scores ( $p\text{-value} = 0.553 > 0.05$ ). Based on this sample, there is no difference in sightline satisfaction scores between females and males.

#### 4.4. Security Hardware

It is expected that the presence of DWTC will be positively related to both men's and women's level of satisfaction. However, it will have a less positive effect on females because they tend to be more skeptical about technology as a means of bolstering security and safety (Loukaitou-Sideris & Fink, 2009; Yavuz & Welch, 2010). Accordingly, the following hypothesis was developed:

*H4: Female participants will be less satisfied than male participants with security hardware in the presence of digital wait time clocks.*

A two-sample t-test with 60 degrees of freedom was performed to test for a difference in means in security hardware satisfaction scores by gender in the presence of DWTC. This sample includes participants who rated two photos with DWTC. The test revealed no significant difference in mean satisfaction scores by gender ( $p\text{-value}=0.836 > 0.05$ ). The 95% confidence interval contains zero and the null hypothesis cannot be rejected.



A regression was calculated to test for a gender (b1) and DWTC (b2) interaction on security hardware satisfaction. The interaction term, Gender\*DWTC (b3), was included to see if the relationship between gender and DWTC changed at different levels of the variables. The p-values associated with variables, gender and DWTC, in the original regression model were not statistically significant. The introduction of the interaction term did not change the relationship among the variables. The interaction term was not significant (b3 p-value = 0.88 > 0.05). The effect of DWTC does not change depending on the gender of the participant. Or, equivalently the effect of gender does not change depending on the presence of DWTC.

#### 4.5. Rank Order Platform Security Characteristics

Study participants were asked to rank the presence of eight different characteristics according to its importance to feelings of personal safety on a subway platform, 1 being the most important and 8 being the least important. Table 2 shows the overall means and standard deviations of all the characteristics which are listed from highest (most important) to lowest (least important). Table 3 shows the means and standard deviations of those same characteristics by gender. With the exception of entrance/exit signs, there were no significant differences in the way female and male participants prioritized security characteristics. Overall, platform lighting, the presence of other passengers, and system announcements were found to be significantly different than the other characteristics. Lighting and other passengers were ranked as the most important with mean scores of 1.94 and 2.69, respectively. As evidenced by its high standard deviation (2.23), the importance of other passengers relative to personal safety was not consistent among participant. Some believed it to be very important whereas others tended to give it a

lower ranking. Further investigation revealed no main effects of gender or age on other passenger ranking.

Table 2: Overall Mean Ranking and Standard Deviation of Platform Security Characteristics

	Mean (SD)
Lighting*	1.94 (1.25)
Other Passengers*	2.69 (2.22)
Visible CCTV	4.49 (1.87)
Visible Security Televisions	5.01 (1.91)
Emergency Phones	5.04 (1.90)
Entrance/Exit Signs	5.07 (1.94)
DWTC	5.29 (2.13)
System Announcements*	5.96 (1.83)

\*p<0.05

Table 3: Mean Ranking and Standard Deviation of Platform Security Characteristics by Gender

	Mean (SD)	
	Female (n=92)	Male (n=67)
Lighting	1.96 (1.26)	1.91 (1.26)
Other Passengers	2.78 (2.36)	2.55 (2.07)
Visible CCTV	4.63 (1.94)	4.30 (1.78)
Entrance/Exit Signs*	4.78 (1.88)	5.48 (1.98)
Emergency Phones	4.91 (2.02)	5.21 (1.75)
Visible Security Televisions	4.95 (1.94)	5.09 (1.89)
DWTC	5.23 (2.20)	5.37 (2.04)
System Announcements	5.87 (1.83)	6.07 (1.86)

\*p<0.05

Perhaps what is most interesting about these results is the lack of significant differences among a majority of the characteristics, namely CCTVs, security televisions, and emergency phones. These forms of security hardware are used most often by transit agencies to fight crime

(Loukaitou-Sideris & Fink, 2009; Hedgpeth, 2011). But more so than fighting crime, they are installed with such frequently because cameras, television screens, and phones are quantifiable and tangible efforts the agencies can refer to when security is come into question. According to survey results, these forms of security hardware are not only interchange relative to personal safety, they are also not that important; the mean scores of all three characteristics places them nowhere near the top.

## CHAPTER 5

### Concluding Observations

#### 5.1. Introduction

This chapter begins with the discussion of study limitations and then moves on to the implications of research findings and recommendations. There are a few crucial limitations of this study which, in turn, bound the research finding implications. In this section, the most salient limitations are listed and discussed.

##### 5.1.1. Self-Selection Bias

Self-selection bias is the study's largest limitation. Non-random procedures were used to contact participants and they then selected to take the survey. This severely weakens the study's external validity since it is assumed the sample population is not representative of the true population. This is especially true in this case due to the fact the participants were a young (39% were between the ages of 26-33 years old) and highly educated group (57% earned a graduate or professional degree) which most public transportation users generally are not (Loukaitou-Sideris & Eck 2007). It is therefore highly unlikely that these survey participants represent the travel behaviors, past experiences, or security preferences of those who frequent systems more often. Differences across certain demographics such as education cannot be determined because the ranges in educational level are not diverse enough. Future research on this subject should aim to sample a broader range of people so as to ensure all system users are represented.

### 5.1.2. Instrumentation

Because there was only one form of data collection used in this study, there may be an issue of mono-methods bias and weak construct validity. Though the Likert-scale had a Cronbach alpha score of .68 which suggests modest internal consistency reliability, the instrument is still susceptible to weaknesses. In the future, a mixed methods approach would be more appropriate so as to ensure the strength of the instrument. For example, the survey could be supplemented by an objective audit tool of each subway platform filled out by actual riders. Doing so may provide insight into travel behavior and feelings that are not able to be captured through photos.

### 5.1.3. History & Existing Reputation

It is possible that events, crime reports or newspaper articles may have occurred during the time of the study. This may have influenced respondents' answers in some way. In addition, Washington DC's reputation for being a safe system may have skewed results concerning all three systems. Asking which city each respondent resides in may have provided some additional insight into this weakness. This would have made it possible to determine if certain answers were particular for one specific group of respondents. During the online survey, "Have you ever ridden on this particular subway system before?" was asked after every photo as a way to control for familiarity. However, the order in which the survey provider asked the question made it unusable.

## 5.2. Implications of Research

Results for hypotheses H1a, H1b, and H1c indicate that the original design of a subway system is an important factor in shaping a user's perception of personal safety. The significant difference found in how participants in the survey regarded the perceived safety of the Washington Metro system over the much older New York and Chicago systems underscores the result. Moreover, gender was found to have a main effect on personal safety scores within the Metro system, indicating that women are, on average, less satisfied with their sense of safety. In addition, DWTC, closed circuit television cameras and similar security hardware did little to enhance perception of security. This is evidenced by the results for hypotheses H2a, H2b, and H4. This claim is further supported by participants' ranking of various security features (Table 2 & Table 3). Besides "lighting," "other passengers," and "system announcements," there were no other statistically significant characteristics.

It was noted in chapter one that while transit authorities viewed increased police presence as the most effective way to enhance security, they had, nevertheless, spent large sums on security hardware (Lynch & Atkins, 1988; Loukaitou-Sideris & Fink, 2009). As noted in chapter two, the Washington Metro had given much lip-service to hiring more police, but had done little to implement it (Hedgpath, 2011; Tyson, 2011). While adding hardware may be the less costly and more convenient response, its efficacy is open to doubt. This study confirms the widely shared view of the transit authorities that increased police presence is the most effective way of enhancing the perception of added security among riders, and increased police presence in the subway systems appears to be the best way of encouraging female ridership. Even in the Washington Metro system, a higher police presence is likely to offset some of the adverse impact of its CPTED design on female users.

To shape appropriate policy response, transit authorities need to know the elasticity of demand for their product with respect to additional police presence. That is, percent change in ridership and revenue in response to a one percent change in police presence in the stations. Clearly, if demand in the long run is elastic, spending more on police presence is a wise use of resources. Quantifying the value of police presence in terms of system revenue may catch the attention of transit authorities, and help them better understand that personal safety plays an important part of transportation demand. As of now, transit security professionals mainly concentrate on crime statistics as a means of understanding criminal behavior in public transportation systems. This fails to recognize that transit use success is not exclusively defined in terms of objective statistical analyses of crime data. Tying police presence back to revenue and ridership may help balance the analysis of crime deterrence and success in the operation of transit systems. My point is not that actual crime frequency is unimportant. Rather I believe that transit professionals need to give more weight to perceptions of safety and fear of crime in evaluating the impacts of potential implications of various crime control strategies, including CPED.

In addition, there are important external economies and social benefits from increased use of public transportation, such as less road congestion, less pollution and environmental damage, and reduced stress and waste of time spent traveling, to cite a few. All of this needs to be taken into account when public transit authorities allocate funds to hire more police.

### 5.3. Recommendations

Despite the fact empirical research has shown women are typically more fearful of transportation settings than men, specific considerations of such anxieties are all but missing from the policies of U.S. transit agencies. Like all passengers, women are supposed to benefit from the increased attention to secure public environments in a post 9/11 world. And yet, not one agency has made an effort to offer safety programs and strategies for women. In fact, the Washington Metro system has, arguably, deliberately downplayed instances of rape occurring on Metro property, a crime that particularly affects women. Oddly enough, many transit agencies justly provide special services for other special needs groups. Surprisingly, U.S. Transit operators, interviewed by Loukaitou-Sideris & Fink (2009), acknowledge the specific needs of female passengers but feel as though female passengers are to blame. Travel behavior associated with household duties such as grocery shopping and childcare leave female passengers more susceptible to attack. An overly simplified solution according to transit operators is to simply have female riders change their travel behavior. Attitudes such as this create a culture of blame targeted at women that is allowing important issues go unaddressed. As reported in Chapter 2, the behaviors of the victims of crime on the Washington DC Metro were not out of the ordinary. Furthermore, many women who were interviewed as part of the articles already admitted to changes in travel behavior due to crime. To further place the responsibility of reducing crime in public transit on its most common victims is, in a way, letting the “bad guy win.” It is a reactive as opposed to a proactive approach that would benefit everyone. As identified by this study, there is a mismatch between existing safety and security practices of transit agencies, namely the reliance and preference of security hardware, and the desires of female passengers.



As stated in a Washington Post article (Tyson, 2011), the Department of Homeland Security has provided funding to the Washington Metro and other transit agencies to install CCTV in and around the station vicinities. Specifically for the Metro, these grants are in the millions and provide as many as an additional 153 cameras to monitor the operating 86 stations which already have cameras. This further highlights the agencies and governments over reliance on technological hardware as a response to crime rather than employing preventative tactics than would simultaneously benefit riders.

While the author acknowledges the placement of a police officer at every station is without a doubt beyond the financial capabilities of transit agencies, a number of initiatives may help close this gap. For example, streamlining the process of documenting transit crime could lead to more accurate statistics, more focused crime fighting techniques, and better allocations of funds within the agencies. Furthermore, there will be a greater level of transparency and trust between passengers and transit agencies as passengers are able to better plan their travel behavior. The creation of competitive funding programs that challenge agencies to come up with safety initiatives should be made part of the Office of Homeland Security's distribution of funding. Also useful would be drawing upon successfully CTPED strategies that have been used in other environments and applying it to public transportation. For example, the addition of way finding signage in transportation systems that are often seen in large retail settings, such as shopping malls, may help reduce the incidences of feeling lost and confusion among passengers. Small changes to the built environment such as this can be implemented and tested without having to change the physical structure of the building. Lastly, the addition of women's voices in transportation planning and policy and a greater investment in the understanding of female travel behavior and sentiments would help shrink the gap. These measures and initiatives would be the

first steps in creating a transportation system that serves the needs of female passengers and others alike.

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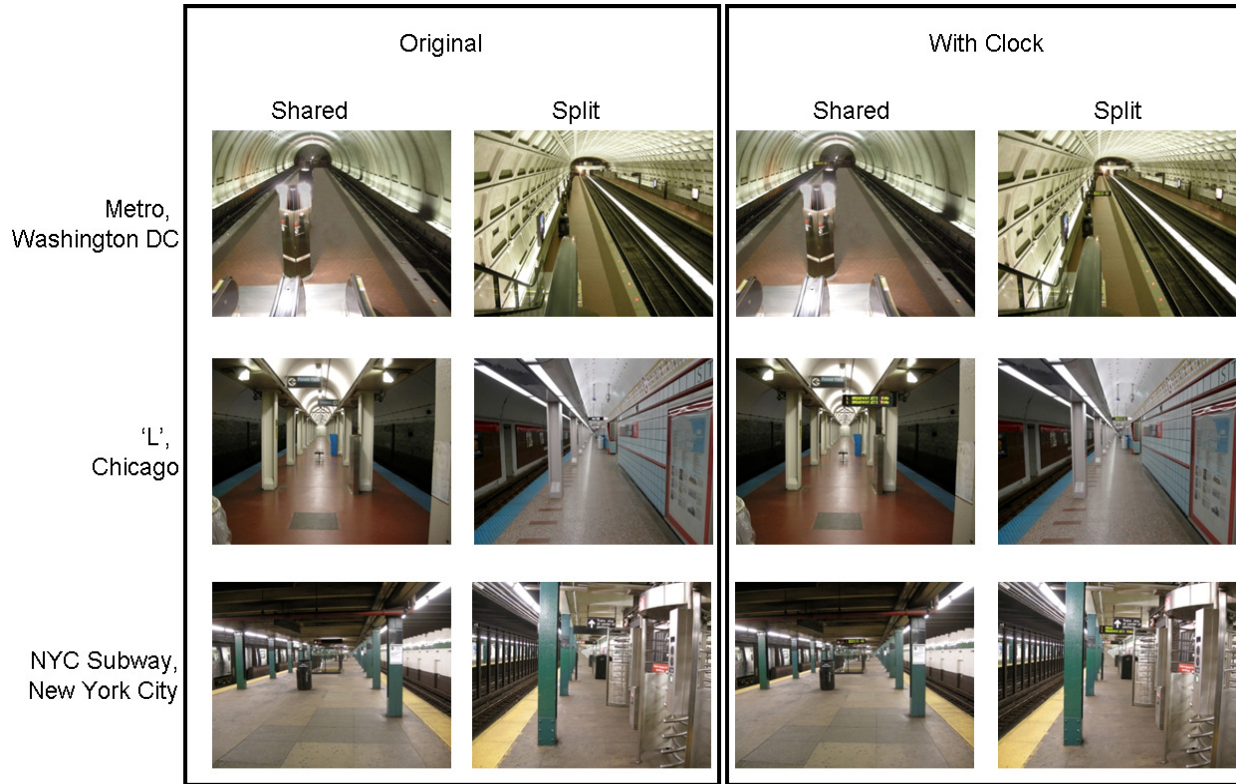
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## Appendix

Appendix 1: Survey Photos. *Survey participants were each randomly shown four of the twelve photos.*





Appendix 2: *Study participants were asked to fill out the following survey.*

**DIRECTIONS:** *Please complete the following survey regarding your gender, age, use of public transportation, and your **personal safety** while using public transportation. **PERSONAL SAFETY** is defined as how protected you feel from violence, discrimination, and verbal assault.*

1. What is your gender?
  - a. Male
  - b. Female
  - c. I don't know/No answer
  
2. How old are you?
  - a. 18-25
  - b. 26-33
  - c. 34-41
  - d. 42-49
  - e. 50-57
  - f. 58 and over
  - g. I don't know/No answer
  
3. What is your highest level of education?
  - a. High school diploma or GED
  - b. College degree
  - c. Graduate or Professional degree
  - d. PhD or Doctorate
  - e. Other \_\_\_\_\_
  - f. I don't know/No answer
  
4. In the past month, approximately how frequently did you use public transportation (i.e. bus, trolleybus, tram, ferry, and metro/subway/underground)?
  - a. Did not use it at all
  - b. Less than once a week
  - c. Once a week
  - d. More than once a week
  - e. Everyday
  - f. I don't know/No answer
  - g. I have never used public transportation (Skip to question 7)
  
5. In the United States, do you ever avoid using the metro/subway/underground because you don't feel safe?
  - a. Yes (Go to question 6)
  - b. No (Skip to question 7)
  - c. I don't know/No answer (Skip to question 7)

6. Precisely, why don't you feel safe using the metro/subway/underground? Circle all answers that apply.
- Traveling alone
  - Previous personal negative experience(s) using public transportation
  - Potentially long wait at the station
  - Time of day
  - Recent negative event(s)/report(s) concerning public transportation safety
  - Traveling to/from the station
  - Other \_\_\_\_\_
  - I don't know/No answer
7. When on a metro/subway/underground platform, which of the characteristics do you feel is important to your personal safety? Please rank the presence of the following characteristics from 1 to 8, where 1 is "the most important to my personal safety," 2 is "the second most important to my personal safety," and so on until you have ranked all characteristics in terms of their importance to you. **PERSONAL SAFETY** is defined as how protected you feel from violence, discrimination, and verbal assault.

<b>Lighting</b>	
<b>Digital Wait Time Clocks</b> ( <i>tells you when the next train is coming</i> )	
<b>Emergency Phones</b>	
<b>System Announcements</b>	
<b>Visible Security Cameras</b>	
<b>Visible Security Television Monitors</b>	
<b>Entrance/Exit Signs</b>	
<b>Other Passengers</b>	

**[PHOTO]**

8. Looking at the picture above, please rate how satisfied you are on a scale of 1 to 5, where 1 is considered "Very unsatisfied" and 5 is considered "Very satisfied," regarding the following:

	1 = Very unsatisfied	2 = Unsatisfied	3 = Neither satisfied nor unsatisfied	4 = Satisfied	5 = Very satisfied	6 = I don't know/No Answer
<b>OVERALL SENSE OF PERSONAL SAFETY</b>	1	2	3	4	5	6
<b>SIGHTLINES</b> ( <i>Ability to see what's up ahead</i> )	1	2	3	4	5	6
<b>SECURITY HARDWARE</b> ( <i>Nonhuman</i> )	1	2	3	4	5	6

<i>technology – i.e. cameras, emergency phones, etc.)</i>						
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9. Have you ridden on this particular subway system before?
  - a. Yes
  - b. No
  - c. I don't know/No answer